

08/894888
89 Rec'd PCT/PTO 29 AUG 1997

Attorney's Docket No. U 011399-2

PATENT

**TRANSMITTAL LETTER TO THE U.S. DESIGNATED OFFICE (DO/US)—
ENTRY INTO THE U.S. NATIONAL STAGE UNDER CHAPTER I**

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP96/00058	11 JANUARY 1996	
TITLE OF INVENTION		
DISPLAY DEVICE		
APPLICANT(S)		
SHINSUKE NISHIDA		

Box PCT
Assistant Commissioner for Patents
Washington D.C. 20231

ATTENTION: DO/US

NOTE: The completion of those filing requirements that can be made at a time later than 20 months from the priority date results from the Commissioner exercising his judgment under the authority granted under 35 USC 371(d). The filing receipt will show the actual date of receipt of the last item completing the entry into the national phase. See 37 CFR 1.491, which states: "An international application enters the national stage when the applicant has filed the documents and fees required by 35 USC 371(c) within the periods set forth in § 1.494 and § 1.495."

WARNING: Where the items are those that can be submitted to complete the entry of the international application into the national phase subsequent to 20 months from the priority date, the application is still considered to be in the international stage. And if mailing procedures are utilized to obtain a date the express mail procedure of 37 CFR 1.10 must be used (because international application papers are not covered by an ordinary certificate of mailing. 37 CFR 1.8(2)(xi)).

NOTE: Documents and fees must be clearly identified as a submission to enter the national stage under 35 USC 371, otherwise the submission will be considered as being made under 35 USC 111. 37 CFR 1.494(f).

1. Applicant herewith submits to the United States Designated Office (DO/US) the following items under 35 U.S.C. 371:

- a. ☒ This express request to immediately begin national examination procedures (35 U.S.C. 371(f)).
- b. ☒ The U.S. National Fee (35 U.S.C. 371(c)(1)) and other fees (37 CFR 1.492) as indicated below:

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date AUG. 29, 1997 in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EH684255051 addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

GERALDINE MARTI

(type or print name of person mailing paper)

Geraldine Marti

Signature of person mailing paper

NOTE: Each paper or fee referred to as enclosed herein has the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 CFR 1.16(b).

WARNING: Certificate of mailing (first class) or facsimile transmission procedures of 37 CFR 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

(Transmittal Letter to the United States Designated Office (DO/US)—Entry into National Stage Under 35 USC 371 [13-6]—page 1 of 7)

EH 6 842 750 51

2. Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
<input type="checkbox"/> *	TOTAL CLAIMS	11 —20=	0	×\$ 22.00=	\$ 0
	INDEPENDENT CLAIMS	1 —3=	0	×\$80.00=	0
	MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+\$260.00	
BASIC FEE**	The international search fee, as set forth in § 1.445(a)(2) to be paid to the US PTO acting as an international Searching Authority: <input type="checkbox"/> has been paid (37 CFR 1.492(a)(2))\$770.00 <input type="checkbox"/> has not been paid (37 CFR 1.492(a)(3))\$1040.00 <input checked="" type="checkbox"/> where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 CFR 1.492(a)(5))\$910.00				
	Total of above Calculations				= 910.00
SMALL ENTITY	Reduction by ½ for filing by small entity, if applicable. Affidavit must be filed also. (note 37 CFR 1.9, 1.27, 1.28)				- 455.00
	Subtotal				455.00
	Total National Fee				\$ 455.00
	Fee for recording the enclosed assignment document \$40.00 (37 CFR 1.21(h)). (See Item 10 below). See attached "ASSIGNMENT COVER SHEET (37 CFR 3.34)".				
TOTAL	Total Fees enclosed				\$ 455.00

* See attached Preliminary Amendment Reducing the Number of Claims.

****WARNING:** "To avoid abandonment of the application, the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 20 months from the priority date: * * * (2) the basic national fee (see § 1.492(a)). The 20-month time limit may not be extended." 37 CFR § 1.494(b).

- i. ☒ A check in the amount of \$ 455.00 to cover the above fees is enclosed.
- ii. ☐ Please charge Account No. _____ in the amount of \$ _____.

A duplicate copy of this sheet is enclosed.

WARNING: If the translations of the international application, oath or declaration and national fee have not been submitted by the applicant within twenty (20) months from the priority date, the applicant will be so notified and given a period of time within which to file the translation and/or oath or declaration in order to prevent abandonment. The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than twenty (20) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than twenty (20) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 will apply. 37 CFR § 1.494(c); Notice of January 7, 1993, 1147 O.G. 29 to 40, at 35.

3. A copy of the International application as filed (35 U.S.C. 371(c)(2)):
- a. ☒ is transmitted herewith.
- b. ☐ is not required, as the application was filed with the United States Receiving Office.
- c. ☐ has been transmitted
- i. ☐ by the International Bureau. Date of mailing of the application (from form PCT/IB/308): _____.
- ii. ☐ by applicant on _____
Date

NOTE: Section 1.494(b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 20 months from the priority date to avoid abandonment. "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies the applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage and applicant has received notice from the International Bureau, applicant need only pay the basic national fee by 20 months from the priority date." Notice of January 7, 1993, 1147 O.G. 29 to 40, at 35.

4. ☒ A translation of the International application into the English language (35 U.S.C. 371(c)(2)):
- a. ☒ is transmitted herewith.
- b. ☐ is not required as the application was filed in English.
- c. ☐ was previously transmitted by applicant on _____
Date

5. ☒ Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. 371(c)(3)):

NOTE: The Notice of January 7, 1993 indicates that 37 CFR § 1.494(d) was "amended to clarify the existing practice that PCT Article 19 Amendments must be submitted by 20 months from the priority date, which time may not be extended." This Notice further advises: "Of course, the failure to do so does not result in loss of the subject matter of PCT Article 19 amendments. The applicant may submit that subject matter in a preliminary amendment filed under Section 1.121. In many cases, filing an amendment under Section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 35. See item 11(c) below.

- a. ☐ are transmitted herewith.
 - b. ☐ have been transmitted
 - i. ☐ by the International Bureau. Date of mailing of the amendment (from form PCT/IB/308): _____.
 - ii. ☐ by applicant on _____
Date
 - c. ☒ have not been transmitted, as
 - i. ☐ no notification has been received that the International Search Authority has received the Search Copy.
 - ii. ☐ the Search Copy was received by the International Searching Authority, but the Search Report has not yet been issued. Date of receipt of Search Copy (from form PCT/ISA/202): _____.
 - iii. ☒ applicant chose not to make amendments under PCT Article 19. Date of mailing of Search Report (from form PCT/ISA/210): _____.
 - iv. ☐ the time limit for the submission of amendments has not yet expired. The amendments, or a statement that amendments have not been made, will be transmitted before the expiration of the time limit under PCT Rule 46.1.
6. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)):
- a. ☐ is transmitted herewith.
 - b. ☐ is not required as the amendments were made in the English language.
 - c. ☒ has not been transmitted for reasons indicated at point 5.c. above.
7. ☒ An oath or declaration of the inventor (35 U.S.C. 371(c)(4)) complying with 35 U.S.C. 115
- a. ☐ was previously submitted by applicant on _____
Date
 - b. ☒ is submitted herewith, and such oath or declaration
 - i. ☐ is attached to the application.
 - ii. ☒ identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3.b. or c. and 5.b; and states that they were reviewed by the inventor, as required by 37 CFR 1.70.
 - iii. ☐ will follow.

II. Other document(s) or information included:

8. ☒ An international Search Report or Declaration under PCT Article 17(2)(a):
- a. ☒ is transmitted herewith.
 - b. ☐ has been transmitted by the International Bureau. Date of mailing (from form PCT/IB/308): _____
 - c. ☐ is not required, as the application was searched by the United States International Searching Authority.
 - d. ☐ will be transmitted promptly upon request.
 - e. ☐ has been submitted by applicant on _____
Date
 - f. ☐ is not transmitted, as the international search has not yet issued.
9. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98:
- a. ☒ is transmitted herewith.
Also transmitted herewith is (are)
 - ☒ Form PTO—1449
 - ☒ Copies of citations listed
 - b. ☐ will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. 371(c).
 - c. ☐ was previously submitted by applicant on _____
Date
10. ☒ An assignment document is transmitted herewith for recording. A separate ☒ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO—1595 is also attached.
- ☒ Please mail the recorded assignment document to:
 - i. ☒ the person whose signature and address appears below.
 - ii. ☐ the following:

11. ☒ Additional documents

- a. ☒ Copy of request (PCT/RO/101)
- b. ☒ International Publication No. WO 97/25705
 - i. ☐ Specification, claims and drawing
 - ii. ☒ Front page only
- c. ☒ Preliminary amendment (37 CFR § 1.121)
- d. ☒ Other FORM PCT/IB/301 & FORM PCT/IB/308

12. ☒ The above checked items are being transmitted

- a. ☐ before the 18th month publication.
- b. ☒ after publication and the article 20 communication, but before 20 months from the priority date.
- c. ☐ after 20 months (revival).

NOTE: Petition to revive (37 CFR 1.137(a) or (b)) is necessary if 35 U.S.C. 371 requirements are submitted after 20 months.

13. ☐ Certain requirements under 35 U.S.C. 371 were previously submitted by the applicant on _____ date _____ namely:

AUTHORIZATION TO CHARGE ADDITIONAL FEES

WARNING: Accurately count claims, especially multiple dependant claims, to avoid unexpected high charges if extra claims are authorized.

- ☒ The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to Account No. 12-0425

- ☒ 37 CFR 1.492(a)(1), (2), (3), and (4) (filing fees)

WARNING: Because failure to pay the national fee within 20 months without extension (37 CFR § 1.494(b)(2)), results in abandonment of the application, it would be best to always check the above box.

- ☐ 37 CFR 1.492(b), (c), and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment, prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

- ☒ 37 CFR 1.17 (application processing fees)

WARNING: While 37 CFR 1.17(a), (b), (c) and (d) deal with extensions of time under § 1.136(a), this authorization should be made only with the knowledge that: "Submission of the appropriate extension fee under 37 CFR 1.136(a) is to no avail unless a request or petition for extension is filed." Notice of November 5, 1985 (1060 O.G. 27).

(Transmittal Letter to the United States Designated Office (DO/US)—Entry into National Stage Under 35 USC 371 [13-6]—page 6 of 7)

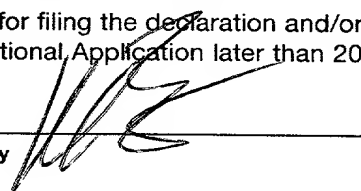
- ☐ CFR 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 CFR 1.311(b)).

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 CFR 1.311(b).

NOTE: 37 CFR 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying or at the time of paying . . . issue fee." From the wording of 37 CFR 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

- ☒ 37 CFR 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 20 months after the priority date.

Signature of attorney



WILLIAM R. EVANS

(type or print name of attorney)

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08/894883

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: SHINSUKE NISHIDA

For: DISPLAY DEVICE

Attorney Docket No.: U 011399-2

**Assistant Commissioner for Patents
Washington, D.C. 20231**

Sir:

PRELIMINARY AMENDMENT

Please amend the above identified application as follows:

IN THE CLAIMS

Claim 3, line 1, delete "or 2"

Claim 4, lines 1-2, delete "any one of claims 1 to 3" and replace therefor

-- claim 1--

CERTIFICATE UNDER 37 1.10

I hereby certify that this paper is being deposited with the United States Postal Service on this date AUGUST 29, 1997 in an envelope as "EXPRESS MAIL POST OFFICE TO ADDRESS-EE" Mailing Label Number EH684275048 addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231

GERALDINE MARTI

(Type or print name of person mailing paper)

Geraldine Marti

(Signature of person mailing paper)

NOTE: Each paper or fee referred to as enclosed herein has the number of the "EXPRESS MAIL" mailing label place thereon prior to mailing 37 CFR 1.16(b).

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Claim 5, lines 1-2, delete "any one of claims 1 to 3" and replace therefor

-- claim 1--

Claim 7, line 3, delete "any one of claims 1 to 3" and replace therefor

-- claim 1--

Claim 9, line 4, delete "any one of claims 4 to 8" and replace therefor

-- claim 4--

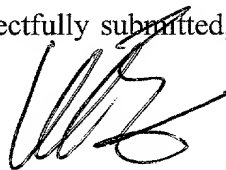
Claim 10, lines 1-2, "any one of claims 4 to 9" and replace therefor

-- claim 4--

Claim 11, lines 1-2, "any one of claims 2 to 10" and replace therefor

-- claim 2--

Respectfully submitted,



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DESCRIPTION

DISPLAY DEVICETechnical Field

The present invention relates to a display device, especially to a type of display which is attached on a wall, such as an electric bulletin board, an advertisement sign board or the like.

Background Art

Wall display devices, such as electric bulletin boards and advertisement sign boards, are widely used as means for providing information to many and unspecific people on streets. Such a wall display device usually includes a number of display elements arranged on a plane in which an individual element is used for one pixel. The respective display elements are electrically actuated in various manner to display information. In an electric bulletin board, for example, one light bulb is used as one display element for one pixel, and a plurality of light bulbs are arranged in matrix. By illuminating those of the light bulbs in specified positions, it is possible to display letters and pictures. Recently electric bulletin boards using light emitting diodes in place of the light bulbs are widely used.

An advertisement sign board uses "panel display elements" as display elements constituting respective pixels. The "panel display elements" are not light emitting themselves but have a plurality of display faces only one of which is actually displayed. Usually one of the display faces to be displayed can be selected by using a rotary mechanism, such as a motor or the like. One display face is selected for each pixel, whereby letters or pictures can be displayed.

The display elements for respective pixels, which are thus provided by light bulbs, light emitting diodes,

panel display elements or the like, are electrically actuated. The light bulbs and the light emitting diodes, for example, can be switched between their light emitting state and non-light emitting state by On/Off control of electric power supply. By conducting the On/Off control on the respective light bulbs or the respective light emitting diodes providing the respective pixels, only required pixels can be selectively illuminated, whereby required information can be displayed. In the panel display elements the On/Off control of electric power supply to the motor is conducted, whereby those of the display faces to be actually displayed can be selected. The On/Off control is conducted on the respective panel display elements providing the respective pixels, whereby a required display face for each pixel can be displayed and required information can be displayed.

In the above-described display devices, needless to say, larger numbers of pixels are necessary for improvement of their display resolution. Accordingly it is necessary that a large number of display elements for respective pixels are arranged in a matrix. As described above, since display manners of the respective display elements must be controlled by electric power supply, it is needed to provide an individual electric power supply line for the individual display elements. In an electric bulletin board having 100 light bulbs arranged in a matrix, for example, two electric power supply lines are needed for each of the 100 light bulbs, and therefore totally 200 lines must be wired from a switchboard to the light bulbs. For high resolution a larger number of light bulbs must be arranged, which increases a number of wiring lines. When a number of wiring lines becomes increased, a structure of a display device becomes complicated, which need much labor for its manufacture and maintenance. This results in higher manufacturing costs and maintenance costs.

A display device for solving such problems is disclosed in the International Application No. PCT/JP95/00901

based on the Patent Cooperation Treaty. In this display device, addresses are defined for every respective display elements and an addressed signal is delivered to a common signal line to thereby independently control the respective display elements thus to simplify wiring. This invention proposes a different technique for simplifying wiring for the respective display elements to facilitate the assembling work and the maintenance work.

Disclosure of Invention

(1) The first feature of the present invention resides in a display device including plural display elements which are arranged in a matrix and have a function to vary display mode corresponding to one pixel by supplying an electric power, the display device comprising:

a plurality of display units each including a display element, a regulator for controlling electric power supply to the display element, memory means for storing display information to instruct the display element to change display mode in time and a controller for controlling the regulator on the basis of the display information stored in the memory means;

a device casing for accommodating and fixing the plurality of display units so that the respective display elements are arranged on a predetermined display screen in a manner adjacent to each other;

an electric power source for producing electric power which is supplied to the display elements; and

electric power transmission means for delivering electric power produced in the electric power source to the regulators within the respective display units, in the state where the respective display units are accommodated within the device casing.

(2) The second feature of the present invention resides in a display device having the first feature:

wherein plural display elements are respectively

provided within each of the display units; and

wherein display information for the respective plural display elements are stored in the memory means .

(3) The third feature of the present invention
5 resides in a display device having the first or second feature:

wherein one display element is constituted by three color presentation elements of a first color presentation element for presenting first primary color R by supplying
10 electric power, a second color presentation element for presenting second primary color G by supplying electric power and a third color presentation element for presenting third color B by supplying electric power.

(4) The fourth feature of the present invention
15 resides in a display device having the first to third feature:

wherein there are further provided;

a central control device for generating a predetermined synchronizing signal delivered to the respective
20 display units; and

signal transmission means for delivering the synchronizing signal generated in the central control device to the controllers within the respective display units;

wherein the respective controllers have a function
25 to control the regulators at timings synchronized with the synchronizing signal delivered thereto.

(5) The fifth feature of the present invention resides in a display device having the first to third feature:

wherein there are further provide;

a central control device for generating a predetermined write signal delivered to the respective
30 display units; and

signal transmission means for delivering the write
35 signal generated in the central control device to the controllers within the respective display units;

wherein the respective controllers have a function to carry out rewrite operation of display information stored in the memory means on the basis of the write signal delivered thereto.

5 (6) The sixth feature of the present invention resides in a display device having the fifth feature:

wherein unique address information for the respective display units are stored in the respective memory means;

10 wherein the write signal comprises address information indicating a specific display unit and display information to be newly written into the memory means within said specific display unit; and

15 wherein the respective controllers have a function to replace display information stored in the memory means by display information within the write signal when address information stored in the memory means and address information within the write signal correspond to each other.

20 (7) The seventh feature of the present invention resides in a display device having the first to third feature:

wherein there are further provided;

a central control device for generating a predetermined write signal delivered to the respective display units; and

25 signal transmission means for delivering the write signal generated in the central control device to the controllers within the respective display units;

30 wherein control programs are respectively stored in the memory means of the display units to allow the controllers to be operative by making reference to the control programs; and

wherein the respective controllers have a function to rewrite the control program stored in the memory means on the basis of the write signal delivered thereto.

35 (8) The eighth feature of the present invention resides in a display device having the seventh feature:

wherein unique address information for the respective display units are stored in the respective memory means;

wherein the write signal comprises address information indicating a specific display unit and control program to be newly written into the memory means within said specific display unit; and

wherein the respective controllers have a function to replace control program stored in the memory means by control program within the write signal when address information stored in the memory means and address information within the write signal correspond to each other.

(9) The ninth feature of the present invention resides in a display device having the fourth to eighth feature:

wherein electric power transmission means and signal transmission means are constituted by a same conductive wire to supply electric power through the conductive wire and to superimpose a component of a signal on voltage of the electric power so that said signal is also transmitted through said conductive wire.

(10) The tenth feature of the present invention resides in a display device having the first to ninth feature:

wherein a signal to be transmitted by the signal transmission means is compressed or encoded in the central control device and the compressed or encoded signal is expanded or decoded within the controller.

(11) The eleventh feature of the present invention resides in a display device having the second to tenth feature:

wherein the controller carries out thinning processing or interpolation processing with respect to display information stored in the memory means.

A display device according to this invention is constituted by providing an array of plural display units within a device casing. Each display unit includes at

least one display element (which carries out display as a pixel), a regulator for controlling supply state of electric power with respect to this display element, a memory, and a controller. For example, the display element is constituted by a light bulb and the regulator is constituted by a relay provided on an electric power transmission passage to the above-mentioned light bulb. In this example, the controller controls the relay to switch the light emitting on or off of the light bulb. Instructions (commands) for the controller are stored as display information in the memory. This display information is information for instructing the respective display elements to change the display mode along time axis. In the above-described example where each display element is constituted by the light bulb and the light emitting or non-light emitting state of this light bulb is switched, it is sufficient to prepare display information of the light emitting or non-light emitting (ON/OFF) state for every unit time which is represented by data of one bit. Assuming that the unit time is one second, a bit data of logic "1" indicates light emitting (ON) state and a bit data of logic "0" indicates non-light emitting (OFF) state, display information of 8 bits expressed as "10100111" in the memory instructs the light bulb to carry out such an operation that it is turned ON for 1 sec., is turned OFF for 1 sec., is turned ON for 1 sec., is turned OFF for 2 sec., and is turned ON for 3 sec.

The feature of the display device according to this invention resides in that individual display units respectively include display information designating (indicating) own display operations as stated above, and the respective display units thus independently carry out display operations. When only electric power is supplied to the device, it can operate even if no instruction (command) is given from the external. Accordingly, if power supply is carried out by way of the common power transmission passage, the respective display units can

start independent display operations without giving any signal from the external. In other words, in the display device according to this invention, since individual display units have intelligence function, if power supply is carried out with respect to all display units, predetermined display operations can be made. When the common power transmission passage is used, even if the number of display units is increased, necessary number of wirings is invariant, so the entire wiring extremely becomes simplified. In addition, since the respective display units are operative on the basis of display information respectively stored in the memories, if predetermined display information are stored in advance in the memories of the respective display units, it is possible to freely set desired display operations.

If plural display units are arranged in longitudinal and lateral directions to constitute a display screen composed of a large number of pixels with respective one display element being as one pixel, it is possible to display arbitrary picture (picture image) on this display screen. Particularly, if display elements corresponding to three primary colors of R, G and B are used, it is possible to form color display screen. Moreover, if a synchronizing signal generated at the central control device is delivered to respective controllers within the respective display units, timings at which display modes of plural display units change can be synchronized with each other. Alternatively, if a predetermined write signal is delivered in place of the synchronizing signal to rewrite the contents of the memories within the respective display units on the basis of information included in the write signal, it is possible to display any picture on demands. It is to be noted that when addresses are defined for respective display units, it becomes possible to deliver a specific write signal only to an addressed specific display unit even if a common signal transmission passage is used.

Further, if a control program for the controller

is stored in the memory, change of the operation can be flexibly carried out by rewriting the control program. In addition, if the controller is caused to have arithmetic processing function, it can execute compression or expansion of data, encode or decode thereof and thinning processing or interpolation processing of pixels.

Brief Description of the Drawings

FIG. 1 is a front view showing the configuration of a conventional typical electric bulletin board.

FIG. 2 is a front view showing the configuration of a display device according to the fundamental embodiment of this invention.

FIG. 3 is a circuit diagram of each display unit 50 used in the electric bulletin board shown in FIG. 2.

FIG. 4 is a Table showing display information stored in memory 52 of the display unit 50 shown in FIG. 3 and the state of light bulb corresponding thereto.

FIG. 5 is a front view showing the configuration of an embodiment in which central control device 70 and signal transmission passage 71 are added to the fundamental embodiment shown in FIG. 2.

FIG. 6 is a circuit diagram of each display unit 50 used in the electric bulletin board shown in FIG. 5.

FIG. 7 is a view showing one example of format of write signal delivered from the central control device 70 in the device shown in FIG. 5.

FIG. 8 is a circuit diagram of an embodiment in which plural signal transmission passages for connecting the central control device and respective display units are provided.

FIG. 9 is a circuit diagram of display unit 80 having display function of R, G, B three primary colors.

FIG. 10 is a partial front view showing the configuration of color display 100 of a structure in which the display units 80 shown in FIG. 9 are arranged.

FIG. 11 is a block diagram showing a drive system of a conventional typical color display.

FIG. 12 is a block diagram showing an embodiment in which color display is constituted by using the display device according to this invention.

Best Mode for Carrying Out the Invention

§0. Conventional electric bulletin board

The present invention will be explained based on an embodiment shown in drawings attached hereto. First, for comparison of the conventional electric bulletin board with the present invention, the structure of the conventional, general electric bulletin board will be explained with reference to FIG. 1. In the conventional electric bulletin board, respective display elements 10 are provided by light bulbs. In this example, display elements 10 are arranged in a five by ten matrix and housed in a device casing 20. A switchboard 30 is provided for supplying electric power to these fifty display elements (light bulbs) 10, and central control device 40 is provided for giving commands to the switchboard 30. Two electric power supply lines 31 are wired to each of the display elements 10 (only a part of the wiring is shown to simplify the drawing). The central control device 40 gives to the switchboard 30 commands as to which display elements 10 are to be electrically activated, based on the information to be displayed (e.g., letters) on this electric bulletin board. Based on the commands, the switchboard 30 supplies electric power to only those of the electric power supply lines 31 associated with the required display elements 10. Only required display elements 10 are thus lit, and information is displayed by using the respective display elements 10 as individual pixels.

As described above, such a conventional electric bulletin board, however, has the problem that the wiring is very complicated. In the example of FIG. 1, two electric

power supply lines are necessary for each of the fifty display elements 10, and therefore totally a hundred electric power supply lines have to be wired. In practical purposes, high resolutions are necessary to display complicated letters and pictures, which needs more display elements 10 so that the wiring becomes more complicated.

The present invention is to provide a technical idea which can avoid such complicated wiring.

§1. Fundamental embodiment of the present invention

FIG. 2 is a front view showing the fundamental embodiment to which the present invention is applied to the above-described electric bulletin board. In this electric bulletin board, individual display elements 10 (light bulbs) are respectively accommodated within display units 50. Similarly to the electric bulletin board of FIG. 1, the respective display units 50 are adjacently arranged in a matrix form of five by ten, and are housed and fixed within a device casing 90. On the other hand, an electric power source 60 is provided for the purpose of generating electric power delivered to these respective display units 50, and electric power generated at the electric power source 60 is delivered to the respective display units 50 through an electric power transmission passage 61.

The important point in this case is that the electric power transmission passage is a transmission passage common to the respective display units 50. In other words, the electric power transmission passage 61 is constituted as a single transmission passage to take a route successively including the first display unit 50, the second display unit 50, the third display unit 50, ..., the 49-th display unit 50 and the 50-th display unit 50. In more practical sense, when two wirings are drawn into the device casing 90 as the electric power transmission passage 61, all wirings are completed. Accordingly, the wiring is extremely simplified as compared to the conventional electric bulletin board shown in FIG. 1. In addition, even if the number of

display units 50 is increased for the purpose of improving the resolution, it is still sufficient to provide two wirings in total.

In order to allow the respective display units 50 to carry out their own individual operations while taking such a structure in which electric power is supplied by the common electric power transmission passage 61, additional components are required to be added to the display elements 10 within the respective display units 50. FIG. 3 is a circuit diagram showing an example of the configuration within one display unit 50. A light bulb as the display element 10 is connected to the electric power transmission passage 61 drawn within the device casing 90 so that the electric power is supplied. In this case, one terminal of the display element 10 is connected to the electric power transmission passage 61 through a regulator 51. Thus, supply state of the electric power to the display element 10 can be controlled by this regulator 51. In more practical sense, the regulator 51 is constituted by a relay, and is capable of carrying out ON/OFF control of power supply to the display element 10 (light bulb). Within the display unit 50, a non-volatile memory 52 and a controller 53 are further provided. Display information for instructing the display element 10 (light bulb) to change its display mode in point of time is stored in the non-volatile memory 52. The controller 53 gives instruction to the regulator 51 on the basis of this display information to carry out ON/OFF control of the display element 10.

FIG. 4 is a Table showing the relationship between an example of display information stored in the non-volatile memory 52 and the state of the light bulb corresponding to this display information. In this example, one second is defined as a unit time and display information, which indicates light emitting or non-light emitting (ON/OFF) state for every unit time by a bit data, is shown at the upper row of the Table. Namely, the display information

consists of bit train, and an n-th bit indicates the display state after n sec. In more practical sense, a bit "1" is defined as a bit data indicating light emitting (ON) state and a bit "0" is defined as a bit data indicating non-light emitting (OFF) state. The light emitting or non-light emitting (ON/OFF) state of the display element (light bulb) is indicated at the lower row of this Table. When reference is made to corresponding portions of both the upper and lower rows, the relevancy between display information prepared and the actual light emitting or non-light emitting (ON/OFF) operations of the light bulb can be readily understood. The controller 53 sequentially reads out such bit train stored in the memory 52 one bit by one bit every predetermined unit time (1 sec. in this embodiment) to carry out ON/OFF control of the regulator 51 on the basis of the bit value thus read out.

In this configuration, since the individual display units 50 are entirely the same in view of hardware, those display units 50 can be mass-produced. If an EEPROM and a processor unit of the clock included type are respectively used as the non-volatile memory 52 and the controller 53, they can be constituted with elements on one chip. Thus, the structure becomes very simple. In view of software, it is possible to write inherent display information, such as a data indicated at the upper row of FIG. 4, into the non-volatile memories 52 of the individual display units 50 by using the controllers 53 at the final stage when these mass-produced display units 50 are accommodated within the device casing 90. Those display units in which the inherent display information are written can function as an electric bulletin board according to this invention. This assembling work is very easy because the wiring step is simplified to much degree. Similarly, maintenance work also becomes easy.

It is to be noted while, in this embodiment, a data of one bit is used for determining the display state

per unit time (1 sec. in this example) to carry out simple ON/OFF control, if, e.g., a data of eight bits is used for determining the display state per unit time, a brightness control with 256 steps of gradation can be also carried out. In this case, it is sufficient that a transistor element, etc. is used as the regulator 51 to vary electric current supply to the display element 10 with 256 steps.

§2 Embodiment using synchronizing signal

In the above-described fundamental embodiment, fifty light bulbs respectively independently carry out light emitting or non-light emitting (ON/OFF) operations. Accordingly, any picture image can be presented on a display screen constituted by the entirety of the display device shown in FIG. 2. As a matter of course, a picture including letters (characters) can be also presented. Further, so-called slide show to switch still pictures every predetermined time can be also presented and moving picture can be also presented. In this case, a number of displaced still pictures or a total display time of the moving picture is limited by capacity of the memory 52. According as the capacity of the memory 52 becomes large, a larger number of still pictures can be presented, and a longer time moving picture display can be made. The pictures presented are determined by display information stored in the memories 52 of the respective display units. In other words, a user of this display device determines in advance what picture is to be presented and stores in advance, in the memories 52 of the respective display units, display information (data of bit train in the above-described example) which is necessary for carrying out such presentation.

It is to be noted that in order to present a meaningful picture when viewed as the entirety of the display device, it is necessary to ensure synchronization between respective display units. Namely, it is necessary to synchronize the timings for switching from a display state corresponding to the n-th bit of the display information

indicated at the upper row of FIG. 4 to the next display state corresponding to the (n+1)th bit of the display information with respect to all the display units. If these timings are not in correspondence with each other for the respective display units, it is impossible to display a correct picture. Accordingly, it is preferable to deliver a synchronizing signal to the respective display units.

FIG. 5 is a front view showing an embodiment in which means for delivering synchronizing signal (SYNC signal) is added to the above-described fundamental embodiment. In this embodiment, central control device 70 and a signal transmission passage 71 are newly provided so that a synchronizing signal generated at the central control unit 70 is transmitted to the respective display units 50 through the signal transmission passage 71. FIG. 6 is a circuit diagram showing an example of the configuration within one display unit 50, wherein the state where the synchronizing signal on the signal transmission passage 71 is taken into the controller 53 is shown. If a clock signal consisting of, e.g., a rectangular wave is used as the synchronizing signal, the controllers 53 of the respective display units can switch the display mode of the display elements 10 at correct timings in correspondence with the period of this clock signal.

It is true that the central control unit 70 and the signal transmission passage 71 are not necessarily required in carrying out this invention. Since it is unnecessary that operation timings of respective display units are precisely synchronized in such cases that random abstract patterns are displayed as a picture image, or in such cases that light is emitted at random as a simple ornament, it is not required to positively use the synchronizing signal. Moreover, when synchronization is taken only at the time of start of the display operation using a start timing of power supply as a trigger, synchronization to a certain extent can be ensured even if

a perfect synchronization cannot be attained.

However, it is to be noted that, in the case of displaying letters (characters), etc., it is preferable to use the synchronizing signal as far as possible. From the physical point of view, the electric power transmission passage 61 and the signal transmission passage 71 shown in FIG. 5 may be constituted by the same conductive wire. For example, if a.c. power is used as power delivered, the period of this a.c. power can be utilized as a clock signal. Accordingly, a pair of conductive wires constituting the electric power transmission passage 61 perform the role as the signal transmission passage 71.

§3 Embodiment using write signal

As previously described, the display contents of the electric bulletin board according to the embodiments mentioned above are determined on the basis of display information (bit train data) stored in the memories 52 within the respective display units. In other words, in these electric bulletin boards, only pictures represented by display information stored in the memories 52 can be displayed. In the case of allowing the electric bulletin board to display different pictures, display information in the memories 52 must be changed. As a method for carrying out change of display information, there are a first method of exchanging the entirety of the hardware of the memory 52, and a second method of rewriting the memory content in terms of software. While the first method is also actually effective in such a case that the same advertisement is repeatedly displayed for a long time, the second method is practical from a general point of view. In view of the above, the embodiment having a function to rewrite display information in the memory 52 will now be described.

Such a rewrite operation can be carried out by delivering a write signal, in place of a synchronizing signal, through the signal transmission passage 71 in the embodiment shown in FIG. 5. In order to allow the display

units 50 to respectively carry out individual rewrite processing by using single common signal transmission passage 71, it is sufficient that addresses are defined with respect to the display units. In the case where fifty display units are disposed as shown in FIG. 5, for example, addresses from the first address up to the fiftieth address are respectively defined with respect to the display units and these addresses are stored in the memories 52 within the respective display units. In more practical sense, address information of the "first address" is written in advance in the non-volatile memory 52 within the first display unit, and address information of the "fiftieth address" is written in advance in the non-volatile memory 52 within the fiftieth display unit.

In this case, the write signal transmitted through the signal transmission passage 71 is caused to consist of address information indicating a specific display unit and display information to be newly written into the memory 52 within the specific display unit. FIG. 7 is a view showing one example of the format of a write signal as stated above, wherein a write signal with respect to the specific display unit consists of "unit data start information" indicating start of the write signal of one unit, "address information" indicating the specific display unit, "display information" to be newly written, and "unit data end information" indicating end of the write signal of one unit.

For example, in the case where there is a need to replace former display information stored in the memory within the third display unit with new display information "11001100...", it is sufficient to generate a write signal including data of "address information: the third address, display information: 11001100..." at the central control device 70 to transmit it to all the display units through the signal transmission passage 71. The controllers 53 within the respective display units are preprogrammed to

execute the rewrite processing only in the case where the own address information assigned to the corresponding controller, which is stored in the memory 52, and address information within the transmitted write signal are in correspondence with each other. When such a preprogram is made, even if the above-mentioned write signal is transmitted to all the display units 50, only the controller 53 within the third display unit 50 in which address information of the "third address" is written in the memory 52 executes the processing to replace the display information in the memory 52 by the new display information "11001100...". Although the same write signal is transmitted to the other forty-nine display units, the controllers 53 within those forty-nine display units do not carry out rewrite processing by any means. It is to be noted that, in order to carry out rewrite operation with respect to plural display units, it is sufficient to repeatedly deliver a write signal as shown in FIG. 7 with address information being respectively changed.

The central control device 70 and the controllers 53 within the respective display units are units including microprocessors, and ordinarily have a function to execute various arithmetic processing in a time of the order of microsecond or less than that. Accordingly, the above-described memory rewrite processing can be executed in such time of the order of microsecond. On the contrary, it is sufficient that a unit time for changing the display mode of the display element 10 (1 sec. in the case of the above-described example) is set to a time to such a degree that the naked eye of human being follows change (the order of millisecond to second). Since the time required for the memory rewrite processing (the order of microsecond) is very short as compared to the switching period of the display mode (the order of millisecond to second), even if the memory rewrite processing is added, any obstruction does not take place in the ordinary switching processing of

the display mode that the controller 53 carries out.

In the device to which such a memory rewrite function is added, the number of still pictures to be displayed or the presentation time of moving picture to be displayed is not limited by the memory capacity. If display information in the memory are sequentially rewritten, it becomes possible to carry out, from a theoretical point of view, presentation of infinite number of still pictures or presentation of moving picture of an infinite time.

It is to be noted that although, in the above-described embodiment, the same write signal is delivered to all the display units through the single common signal transmission passage 71. in the case where a relatively small number of display units are provided, respective dedicated signal transmission passages may be provided for the respective display units. FIG. 8 is a circuit diagram showing an embodiment in which respective dedicated signal transmission passages 72 are drawn from the central control device 70 to four display units 50A, 50B, 50C, 50D. The four signal transmission passages 72 are respectively directly connected to controllers 53A, 53B, 53C, 53D within the display units. In the case where the dedicated signal transmission passages 72 are provided as described above, the address information within the write signal becomes unnecessary, thus making it possible to deliver the write signal at a higher speed.

§ 4. Embodiment applied to color display

Subsequently, the embodiment in which this invention is applied to the color display using light emitting diode will be described. FIG. 9 is a circuit diagram of a display unit 80 having display function of R, G, B three primary colors, and FIG. 10 is a partial front view showing the configuration of a color display 100 of a structure in which a large number of such display units are arranged in a matrix form.

As indicated in the circuit diagram of FIG. 9, three light emitting diodes 83R, 83G, 83B are included as

respective display elements within one display unit 80. These light emitting diodes are diodes supplied with electric power from the electric power transmission passage 61 and respectively carry out light emitting operations of three primary colors of red, green and blue. By these three light emitting diodes, color display corresponding to one pixel can be carried out. Power supplies with respect to the light emitting diodes 83R, 83G, 83B are respectively controlled by regulators 84R, 84G, 84B. The controller 81 gives instructions to the respective regulators 84R, 84G, 84B on the basis of display information stored in a non-volatile memory 82. The respective regulators control energizing to the respective light emitting diodes on the basis of these instructions. In this example, the controller 81 is supplied with a synchronizing (SYNC) signal through the signal transmission passage 71. Thus, changes of the display modes of the respective display units are caused to take place in response to (in synchronism with) the synchronizing signal.

Accordingly, it is necessary to respectively store display information in the memory 82 for every respective light emitting diodes. If a relay is used as a regulator to carry out simple ON/OFF control, it is sufficient to prepare one bit of data for each light emitting diode for indicating the display state during one unit time. If a transistor is used as a regulator to carry out control with brightness changes of, e.g., 256 stages of gradation, it is sufficient to prepare eight bits of data for each light emitting diode for indicating the display state during one unit time.

As shown in FIG. 10, the respective display units 80 are regular square when viewed from the front, and three light emitting diodes 83R, 83G, 83B are accommodated within a unit case 85 functioning as an envelope. Although not shown in FIG. 10, other components shown in the circuit diagram of FIG. 9 are accommodated as electronic parts

within the unit case 85. On the front of the unit case 85, a light transmissive panel 86 is attached. When viewed from the front, the three light emitting diodes 83R, 83G, 83B are accommodated behind the light transmissive panel 86. The display units 80 of such a structure are housed in the state arranged in length and breadth directions within the device casing 90. The device casing 90 includes a rectangular frame portion 91 (only one portion of the left and upper portion thereof is shown in FIG. 10), and a bottom portion (which is not shown in FIG. 10) formed on the bottom surface thereof so as to cover the inside opening portion of the frame portion 91. A large number of display units 80 are put and arranged on the bottom portion.

In this example, the color display 100 further includes, although not shown in the figure, electric power source 60, electric power transmission passage 61 for delivering electric power to the respective display units 80, central control device 70 and signal transmission passage 71 for delivering the synchronizing signal to the respective display units 80. Of course, a write signal can be delivered through the signal transmission passage 71, thereby also making it possible to rewrite display information in the memory 82. If display information is sequentially rewritten, an arbitrary color picture can be displayed similarly to the conventional typical color display.

FIG. 11 is a block diagram showing the drive system of a conventional typical color display 200. When picture data is written into a picture memory 220 (so called frame buffer) by a CPU 210, a display controller 230 delivers a predetermined video signal to the color display 200 so as to carry out picture display corresponding to the picture data. This is the conventional typical color display drive method. In accordance with this method, according as the screen size of the color display 200 becomes greater, or the resolution of picture on screen

becomes higher, the memory capacity required for the picture memory 220 is increased to more degree. As a result, high access speed is required. In addition, high speed and high grade processing ability is required also for the display controller 230.

On the contrary, in the case where this invention is applied to the color display, it becomes unnecessary to provide large capacity picture memory 220 and enhanced function display controller 230. FIG. 12 is a block diagram showing main components in the case where the display device according to this invention is used to constitute the color display. The major portion of the color display 300 is composed of plural display units 330. The main components of each display unit 330 are a controller 331, a memory 332 and a display element 333. Within each display unit 330, the controller 331 carries out processing to control display mode of the display element 333 on the basis of display information stored in the memory 332, and is operative so that when a write signal is given through a signal transmission passage 321 from a central control device 320. Further, the controller 331 carries out processing to rewrite display information in the memory 332 on the basis of the above-mentioned write signal.

The central control device 320 carries out a processing to generate a predetermined write signal on the basis of instruction from a CPU 310 to deliver it to the respective display units 330. As previously described, the transfer time of the write signal between the central control device 320 and the respective display units 330 is the order of microsecond and is sufficiently short as compared to the period that the controller 331 changes the display mode of the display element 333 (order of millisecond to second). Accordingly, even if the rewrite processing with respect to the memory 332 is added, any obstruction does not take place in the ordinary display processing. Moreover, since the memory 332 within each display unit 330

is only required to have a capacity sufficient for only holding display information with respect to the area which the own memory is in charge of among the entire picture area as a color display, there is no necessity for the memory 332 to use a memory element with large capacity or high access speed. Similarly, since the controller 331 within each display unit 330 is only required to have a function to merely carry out control with respect to the area which the own controller is in charge of among the entire picture area as the color display, a high grade arithmetic processing ability is not required as the controller 331. As stated above, according to this invention, the burden of the memory 332 and the controller 331 within each display unit in the color display becomes light to such a degree, because an area which each component is in charge of is reduced as compared to the picture memory 220 and the display controller 230 in the conventional color display drive system. As a result, those components can be constituted with relatively inexpensive electronic parts.

§ 5. Other modifications

While this invention has been described in accordance with the illustrated embodiments, this invention is not limited to these embodiments, but may be carried out in various modes in addition to the above described mode. Several modifications are indicated below.

(1) While light bulbs or light emitting diodes are used as individual display elements in the above-described embodiments, the display elements in the fundamental idea of this invention are not limited only to such light emitting elements. For example, there may be employed a panel type display element, etc. having a structure of three-dimensional body with plural display surfaces wherein a specific display surface can be selectively presented at a time by rotating the body by motor, etc. In short, this invention may be applied to any display devices in which a large number of display elements are arranged on a screen

as pixels and respective display elements have a function to vary their own display mode using electric power drive system to thereby carry out display of information on the screen.

5 (2) The non-volatile memory and the controller are respectively prepared by EEPROM and microprocessor, etc., in the above-described embodiments. However, any memory having the property to hold storage content also after the power supply is turned OFF may be used as the non-volatile memory. As the controller, if the component having function as described above is provided, the wired logic circuit or the transistor circuit may be used. Further, as the non-volatile memory, not only so called semiconductor memory, but also element for mechanically storing information, e.g., DIP switch, etc. may be used. In addition, if it is the premise that rewrite operation of display information is carried out through the signal transmission passage, the memory portion in which display information is stored may be constituted with volatile memory such as RAM, etc.

10 (3) As previously described, the electric power transmission passage 61 and the signal transmission passage 71 may be caused to be commonly used to transmit electric power and display signal in the superimposed state by way of physically the same conductive wire. Moreover, it is not necessarily required to use physical conductive wire for transmitting electric power or display signal to respective display units. For example, supply of electric power or display signal may be also carried out by magnetic coupling, and display signal may be also delivered to respective display units by utilizing radio or light (e.g., infrared ray). Particularly, if optical fiber is used as the signal transmission passage 71, it becomes possible to transmit the write signal at a high speed. In addition to this, even if the number of display units is increased, drawback such as voltage drop, etc. does not take place.

5 (4) While one pixel is constituted by a single display unit in the above-described embodiments, a plurality of display elements corresponding to plural pixels may be included within a single display unit. While, in the embodiment shown in FIG. 10, for example, three light emitting diodes 83R, 83G, 83B are included within a single display unit 80 to carry out display of one pixel by these three light emitting diodes, e.g., a group in which these display units 80 are arranged in a matrix form of four rows by four columns may be handled as a single display unit. In this case, sixteen sets of pixel component each comprised of three light emitting diodes are provided within the single display unit so that forty-eight light emitting diodes in total and forty-eight regulators in total are included therewithin. In such a configuration, it is still sufficient to provide single memory and single controller for the single display unit, since display information with respect to respective forty-eight light emitting diodes can be stored into the single memory.

20 (5) While, in the above-described embodiments, the controller within each display unit executes a processing determined in advance (display processing to control respective regulators on the basis of display information in the memory and processing to rewrite display information in the memory when the write signal is given), if a design is made such that the controller executes these processing by making reference to a predetermined control program stored in the memory, an approach may be employed to rewrite the control program in the memory to thereby suitably change the processing content of the controller.

30 For example, in the circuit diagram shown in FIG. 6, it is sufficient to store, in advance, both the display information and the control program in the memory 52 within the display unit 50. The controller 53 executes the control program stored in the memory 52 to thereby execute display processing to control the regulator 51 and processing

to rewrite the display information in the memory 52 on the basis of the write signal delivered from the signal transmission passage 71. If a given write signal includes an instruction for rewriting display information, a rewrite operation of the display information in the memory 52 is executed and the display mode of the display element 10 is changed as has been described in the aforesaid embodiments. On the other hand, if a given write signal includes an instruction for rewriting control program, a rewrite operation of the control program in the memory 52 is executed and the processing operation itself of the controller 53 can be changed.

Of course, by giving a write signal with a respective address in the case of carrying out rewrite operation of the control program, different rewrite operations of control programs for respective display units can be carried out, even if a common signal transmission passage is used.

(6) As the controller within each display unit, any device having a function capable of controlling the regulator on the basis of display information in the memory may be used. For example, the controller may be constituted by a gate array or a PLA element. It is to be noted that if a device having arithmetic processing function is used as a controller, data within the write signal delivered through the signal transmission passage 71 can be transmitted in the compressed state. For example, in the case of transmitting a write signal as shown in FIG. 7 from the central control device 70, data of the portion of the display information can be compressed in advance. In the case where such a transmission of compressed data is carried out, the controller 53 shown in FIG. 6 receives display information in the compressed state. In this instance, if processing program for expanding the compressed data is included in advance (or is stored in the memory 52), the received compressed data may be expanded to store it into the memory 52. Alternatively, such an approach may

be employed that the controller 53 stores display information into the memory 52 in the compressed state when it received and it expands the stored compressed data when it reads out every time to carry out the actual display. Such a data compression is effective particularly in the case of presenting moving picture.

Further, data may be changed to coded data. For example, let consider the case where sixty-four light bulbs arranged in eight by eight matrix are included as display elements within one display unit. Then a hundred of such display units are arranged in ten by ten matrix to constitute an electric bulletin board. In this case, one letter (character) of alphabetic figure consisting of eight by eight dots can be displayed by one display unit. Thus, display of a hundred letters (characters) can be made as the entirety of the electric bulletin board. On the other hand, display information with respect to sixty-four light bulbs are respectively stored in the memories within the display units. In such a case, bit map data of specific letters (characters) consisting of sixty-four bits (data designating light emitting or non-light emitting state with respect to respective sixty-four light bulbs) are stored into the memory as display information. In place of this, ASCII code, etc. of a specific letter (character) can be also stored as display information. Since the controller 53 has the arithmetic processing function, it is sufficient to carry out decoding work for expanding bit map data of an eight by eight matrix on the basis of the ASCII code which has been read out from the memory 52. If coded data is used in place of actual picture data (bit map data) as described above, data capacity of the write signal delivered through the signal transmission passage from the central control device can be reduced.

Moreover, function to carry out thinning processing or interpolation processing between or with respect to pixels may be added to the controllers within respective

display units. This is effective in the case where a resolution of pixel arrangements of plural display elements in the display unit and a resolution of display information stored in the memory are not in correspondence with each other. For example, let consider the case where sixty-four light bulbs arranged in eight by eight matrix are included as display elements within one display unit. There is no problem in the case where display information in the memory is picture information similarly having the resolution of eight by eight. However, in the case where that display information is picture information having resolution of sixteen by sixteen, it is sufficient to execute thinning processing of pixels at the controller to reduce the resolution so that eight by eight is provided. In contrast, in the case where display information in the memory is picture information having resolution of four by four, it is sufficient to execute interpolation processing of pixels at the controller to increase the resolution so that eight by eight is provided.

In addition, not only the above-described spatial thinning processing or interpolation processing, but also the thinning processing or the interpolation processing in point of time can be carried out. For example, in the case where display information in the memory is moving picture information which varies the display state every 1 sec, an approach may be employed at the controller to thin such moving picture information into 1/2 to vary the display state every 2 sec, or to carry out interpolation in a manner opposite to the above to generate an intermediate display state to vary the display state every 0.5 sec.

Industrial Applicability

A display device according to this invention can be widely utilized for electric bulletin boards or large display devices in which a large number of light bulbs, light emitting diodes or rotational panels are arranged.

Particularly, this display device can be utilized as a display for advertising propaganda in the place where people are gathered such as station or plaza, etc. Such a utilization form to repeatedly present a moving picture of several minutes can be made. In addition, if the display device itself of this invention is utilized as a part of architecture such as a wall, etc., the architecture can provide an intelligent illuminating function.

C L A I M S

1. A display device including plural display elements which are arranged in a matrix and have a function to vary display mode corresponding to one pixel by supplying an electric power, the display device comprising:

a plurality of display units (50; 80; 330) each including a display element (10; 83R, 83G, 83B; 333), a regulator (51; 84R, 84G, 84B) for controlling electric power supply to the display element, memory means (52; 82; 332) for storing display information to instruct the display element to change display mode in time and a controller (53; 81; 331) for controlling the regulator on the basis of the display information stored in the memory means;

a device casing (90) for accommodating and fixing the plurality of display units so that the respective display elements are arranged on a predetermined display screen in a manner adjacent to each other;

an electric power source (60) for producing electric power which is supplied to the display elements; and

electric power transmission means (61) for delivering electric power produced in the electric power source to the regulators within the respective display units, in the state where the respective display units are accommodated within the device casing.

2. A display device as set forth in claim 1:

wherein plural display elements (83R, 83G, 83B) are respectively provided within each of the display units (80); and

wherein display information for the respective plural display elements are stored in the memory means (82).

3. A display device as set forth in claim 1 or 2:

wherein one display element is constituted by

three color presentation elements of a first color presentation element (83R) for presenting first primary color R by supplying electric power, a second color presentation element (83G) for presenting second primary color G by supplying electric power and a third color presentation element (83B) for presenting third color B by supplying electric power.

4. A display device as set forth in any one of claims 1 to 3, wherein there are further provided:

a central control device (70; 320) for generating a predetermined synchronizing signal delivered to the respective display units; and

signal transmission means (71; 321) for delivering the synchronizing signal generated in the central control device to the controllers within the respective display units;

wherein the respective controllers have a function to control the regulators at timings synchronized with the synchronizing signal delivered thereto.

5. A display device as set forth in any one of claims 1 to 3, wherein there are further provide:

a central control device (70; 320) for generating a predetermined write signal delivered to the respective display units; and

signal transmission means (71; 321) for delivering the write signal generated in the central control device to the controllers within the respective display units;

wherein the respective controllers have a function to carry out rewrite operation of display information stored in the memory means on the basis of the write signal delivered thereto.

6. A display device as set forth in claim 5:

wherein unique address information for the respective display units are stored in the respective memory means;

wherein the write signal comprises address information indicating a specific display unit and display information to be newly written into the memory means within said specific display unit; and

5 wherein the respective controllers have a function to replace display information stored in the memory means by display information within the write signal when address information stored in the memory means and address information within the write signal correspond to each other.

10 7. A display device as set forth in any one of claims 1 to 3, wherein there are further provided:

a central control device (70; 320) for generating a predetermined write signal delivered to the respective display units; and

15 signal transmission means (71; 321) for delivering the write signal generated in the central control device to the controllers within the respective display units;

20 wherein control programs are respectively stored in the memory means of the display units to allow the controllers to be operative by making reference to the control programs; and

25 wherein the respective controllers have a function to rewrite the control program stored in the memory means on the basis of the write signal delivered thereto.

8. A display device as set forth in claim 7:

wherein unique address information for the respective display units are stored in the respective memory means;

30 wherein the write signal comprises address information indicating a specific display unit and control program to be newly written into the memory means within said specific display unit; and

35 wherein the respective controllers have a function to replace control program stored in the memory means by control program within the write signal when address

information stored in the memory means and address information within the write signal correspond to each other.

9. A display device as set forth in any one of claims 4 to 8:

wherein electric power transmission means and signal transmission means are constituted by a same conductive wire to supply electric power through the conductive wire and to superimpose a component of a signal on voltage of the electric power so that said signal is also transmitted through said conductive wire.

10. A display device as set forth in any one of claims 4 to 9:

wherein a signal to be transmitted by the signal transmission means is compressed or encoded in the central control device and the compressed or encoded signal is expanded or decoded within the controller.

11. A display device as set forth in any one of claims 2 to 10:

wherein the controller carries out thinning processing or interpolation processing with respect to display information stored in the memory means.

ABSTRACT

In a display device, wiring for the respective display elements is simplified so that the assembling work and the maintenance work become easy. A large number of display units (50) are arranged in length and breadth directions to form the display device. Each display unit comprises a display element (10) comprised of a light bulb, a regulator (51) comprised of a relay, a non-volatile memory (52) comprised of an EEPROM and a controller (53) including a CPU. For these display units (50), a passage (61) for power supply and a passage (71) for supply of synchronizing signal are drawn. Display information to designate change of display mode in time of light emitting or non-light emitting (ON/OFF) state are stored in memories within the respective display units. The controllers of the respective display units carry out ON/OFF control of regulators on the basis of the display information in synchronism with the synchronizing signal to turn ON or OFF the display elements. If a rewrite signal is delivered to the signal transmission passage, the contents of the respective memories can be also rewritten.

U 011399-2

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

☒ In re application of: Shinsuke NISHIDA
 Serial No.: 0 / Group No.
 Filed: Examiner:
 For: DISPLAY DEVICE

☐ Patent No.: _____ Issued: _____

*NOTE: Insert name(s) of inventor(s) and title also for patent. Where statement is with respect to a maintenance fee payment also insert application serial number and filing date and add Box M. Fee to address.

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(c-f) and 1.27(b-d))**

With respect to the invention described in

- ☒ the specification filed herewith.
- ☐ application serial no. 0 / _____, filed _____
- ☐ patent no. _____, issued _____

I. IDENTIFICATION OF DECLARANT AND RIGHTS AS A SMALL ENTITY

I hereby declare that I am

(complete either (a), (b), (c) or (d) below):

(a) Independent Inventor

- ☐ a below named independent inventor and that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code to the Patent and Trademark Office.

(b) Non-inventor Supporting a Claim By Another

- ☐ making this verified statement to support a claim by

for a small entity status for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code and I hereby declare that I would qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under 41(a) and (b) of Title 35, United States Code, if I had made the above identified invention.

(c) Small Business Concern

- ☒ the owner of the small business concern identified below:
- ☐ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN Fourie, Inc.
ADDRESS OF CONCERN 26-10, Setagaya 4-chome, Setagaya-ku,
Tokyo 154 JAPAN and

(Verified Statement (Declaration) Claiming Small Entity Status (37 CFR 1.9 (c-f) and 1.27 (b-d)) [7-10]—page 1 of 4)

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11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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☐ an official empowered to act on behalf of the nonprofit organization identified below:

ADDRESS OF ORGANIZATION _____

☐ UNIVERSITY OR OTHER INSTITUTION OF HIGHER EDUCATION

☐ TAX EXEMPT UNDER INTERNAL REVENUE SERVICE CODE (26 USC 501(a) and 501(c) (3))

☐ NONPROFIT SCIENTIFIC OR EDUCATIONAL UNDER STATUTE OF STATE OF THE UNITED STATES OF AMERICA

(NAME OF STATE _____)

(CITATION OF STATUTE _____)

☐ WOULD QUALIFY AS TAX EXEMPT UNDER INTERNAL REVENUE SERVICE CODE (26 USC 501(a) and 501(c) (3)) IF LOCATED IN THE UNITED STATES OF AMERICA

☐ WOULD QUALIFY AS NONPROFIT SCIENTIFIC OR EDUCATIONAL UNDER STATUTE OF STATE OF THE UNITED STATES OF AMERICA IF LOCATED IN THE UNITED STATES OF AMERICA

(NAME OF STATE _____)

(CITATION OF STATUTE _____)

II. OWNERSHIP OF INVENTION BY DECLARANT

☐ person
(item (a) or (b) above)

☒ concern
(item (c) above)

☐ organization
(item (d) above)

(Verified Statement (Declaration) Claiming Small Entity Status (37 CFR 1.9 (c-f) and 1.27 (b-d)) [7-10]—page 2 of 4)

EXCEPT, that if the rights held are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held (1) by any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, (2) any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or (3) a non-profit organization under 37 CFR 1.9(e).

- ☒ no such person, concern, or organization
☐ person, concerns or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27).

FULL NAME _____

ADDRESS _____

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

FULL NAME _____

ADDRESS _____

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

III. ACKNOWLEDGEMENT OF DUTY TO NOTIFY PTO OF STATUS CHANGE

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

IV. DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

V. SIGNATURES

(complete only (e) or (f) below)

(e)

NOTE: All inventors must sign the verified statement.

Name of Inventor

Date: _____

Signature of Inventor

(Verified Statement (Declaration) Claiming Small Entity Status (37 CFR 1.9 (c-f) and 1.27 (b-d)) [7-10]—page 3 of 4)

Name of Inventor

Date: _____

Signature of Inventor

Name of Inventor

Date: _____

Signature of Inventor

(add lines for any additional inventors who must sign)

or

(f)

NOTE: The title of the person signing on behalf of a concern or non-profit organization should be specified.

NAME OF PERSON SIGNING Shinsuke NISHIDA

TITLE OF PERSON owner
(if signing on behalf of a concern or non-profit organization)

ADDRESS OF PERSON SIGNING #504, Oyamadai Riverside Hidence,
23-14, Tamatsutsumi 1-chome, Setagaya-ku, Tokyo 158 JAPAN

SIGNATURE Shinsuke NISHIDA DATE July 25 1997

(Verified Statement (Declaration) Claiming Small Entity Status (37 CFR 1.9 (c-f) and
1.27 (b-d)) [7-10]—page 4 of 4)

U 011399-2

Attorney's Docket No. _____

PATENT

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,
CONTINUATION OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

- ☐ original
- ☐ design
- ☐ supplemental

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

- ☒ national stage of PCT

NOTE: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.

- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (C-I-P)

INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

DISPLAY DEVICE

SPECIFICATION IDENTIFICATION

the specification of which: (complete (a), (b) or (c))

- (a) ☐ is attached hereto.
- (b) ☐ was filed on _____ as ☐ Serial No. 0 / _____
or ☐ Express Mail No., as Serial No. not yet known _____
and was amended on _____ (if applicable).

(Declaration and Power of Attorney [1-1]—page 1 of 5)

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NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

- (c) ☒ was described and claimed in PCT International Application No. PCT/JP96/00058 filed on January 11, 1996 and as amended under PCT Article 19 on _____ (if any).

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information

- ☒ which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56

(also check the following items, if desired)

- ☐ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent, and
- ☐ In compliance with this duty there is attached an information disclosure statement in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119)

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

- (d) ☒ no such applications have been filed.
- (e) ☐ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

**A. PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>

**ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

NOTE: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

14
PAUL B. WEST, 18947
JOSEPH H. HANDELMAN, 26179
JOHN RICHARDS, 31053
JOHN J. CRYSTAL, 26360
RICHARD J. STREIT, 25765
ALAN K. ROBERTS, 17777
S. DEVALLE GOLDSMITH, 14383

PETER D. GALLOWAY, 27885
IAIN C. BAILLIE, 24090
THOMAS F. PETERSON, 24790
RICHARD P. BERG, 28145
JULIAN H. COHEN, 20302
WILLIAM R. EVANS, 25858
JANET I. CORD, 33778

(check the following item, if applicable)

- ☐ Attached as part of this declaration and power of attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

LADAS & PARRY
26 WEST 61ST STREET
NEW YORK, NEW YORK 10023

(212)708-1930

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name as it should appear on the filing receipt and all other documents.

Full name of sole or first inventor

Shinsuke

(GIVEN NAME)

(MIDDLE INITIAL OR NAME)

NISHIDA

FAMILY (OR LAST NAME)

Inventor's signature

Shinsuke NISHIDA

Date July 25, 1997

Country of Citizenship Japan

Residence same as the post office address

Post Office Address #504, Oyamadai Riverside Hidence, 23-14,

Tamatsutsumi 1-chome, Setaqava-ku, Tokyo 158 JAPAN JFX

Full name of second joint inventor, if any

(GIVEN NAME)

(MIDDLE INITIAL OR NAME)

FAMILY (OR LAST NAME)

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address

(GIVEN NAME) (MIDDLE INITIAL OR NAME) FAMILY (OR LAST NAME)

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

☐ Signature for fourth and subsequent joint inventors. *Number of pages added*

• • •

• • •

• • •

• • •

☐ Number of pages added _____

• • •

• • •

☒ This declaration ends with this page.

Fig.1

PRIOR ART

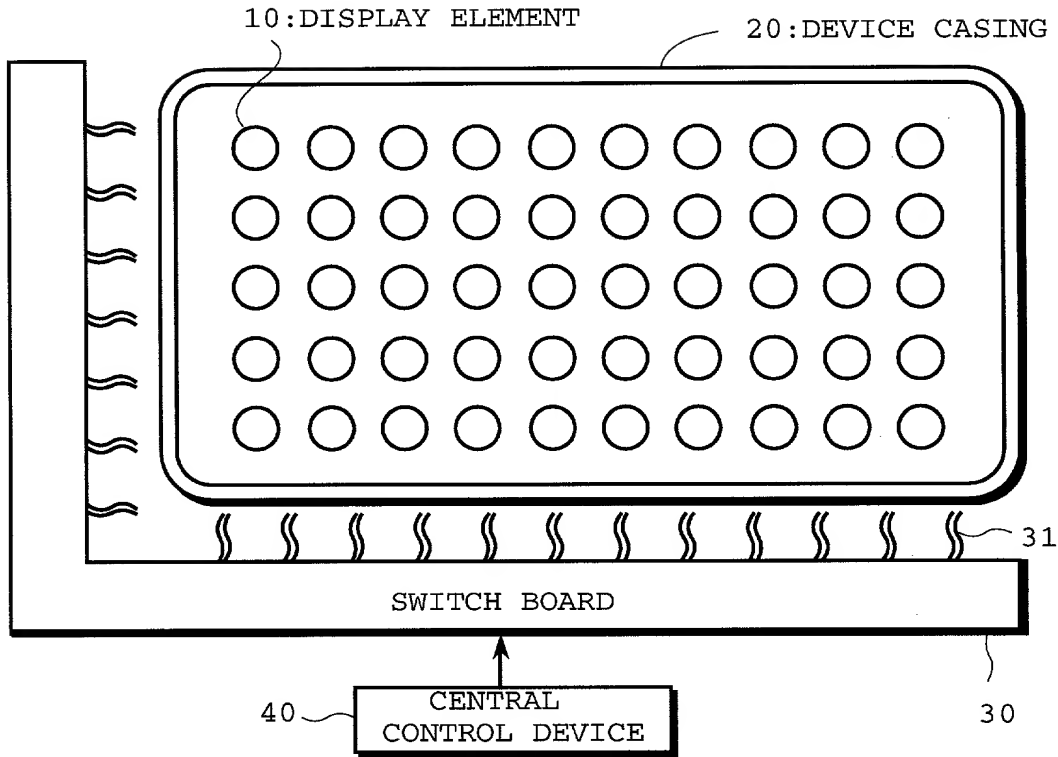


Fig.2

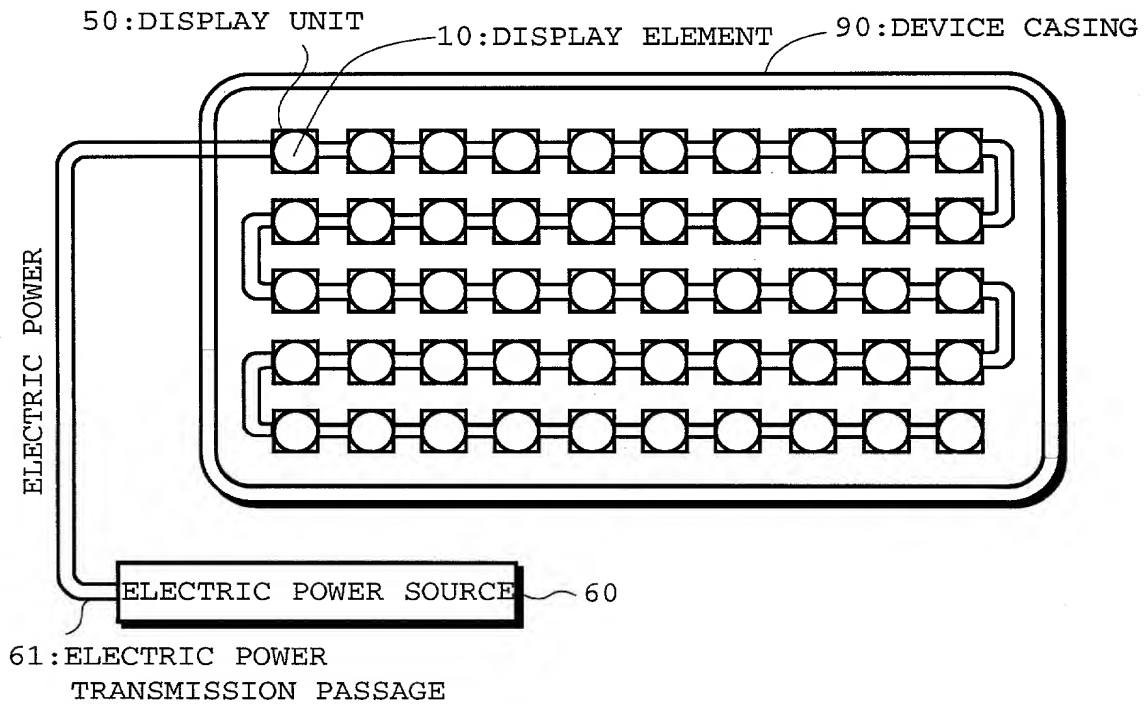


Fig.3

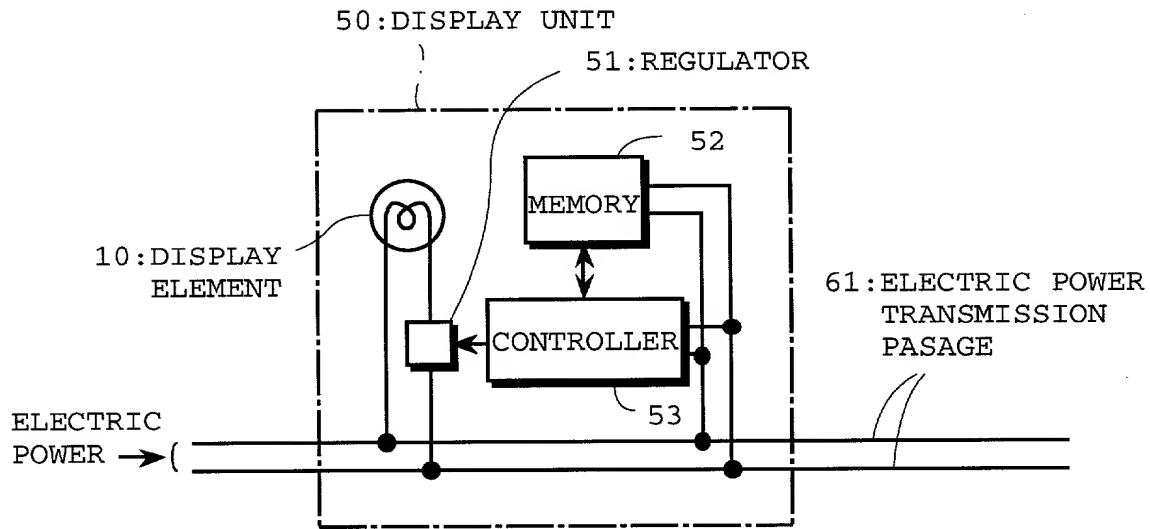


Fig.4

DISPLAY INFORMATION	1	0	1	0	0	1	1	1	
STATE OF LIGHT BULB	ON	OFF	ON	OFF		ON			
	1sec								

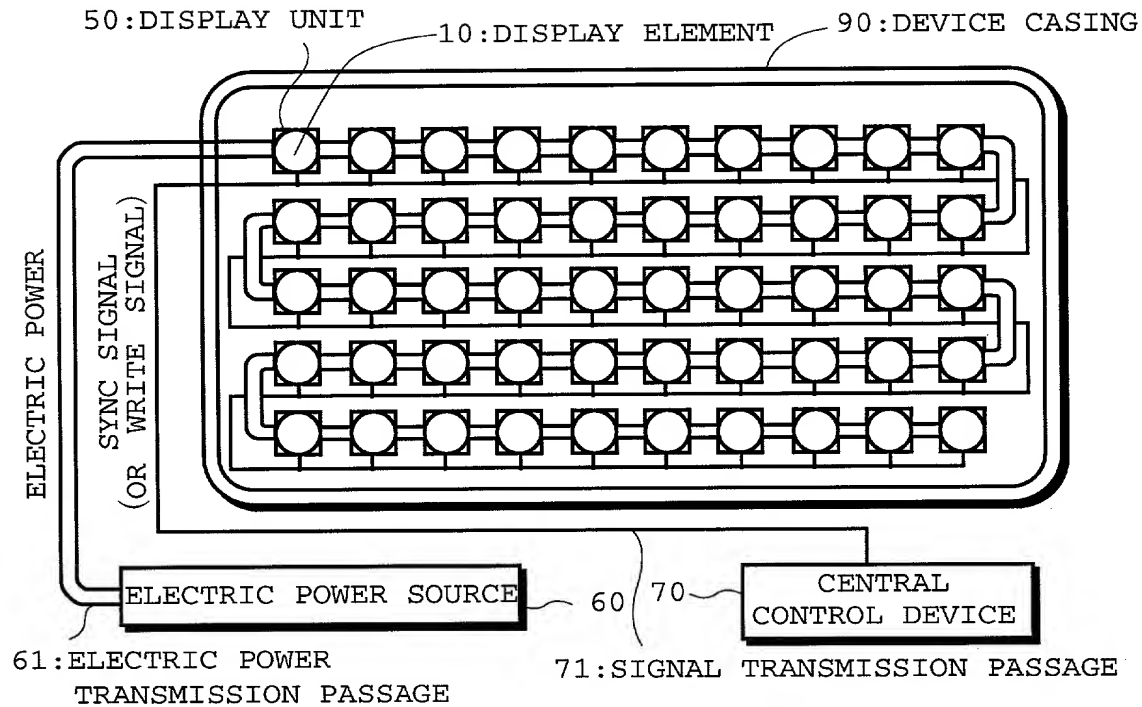
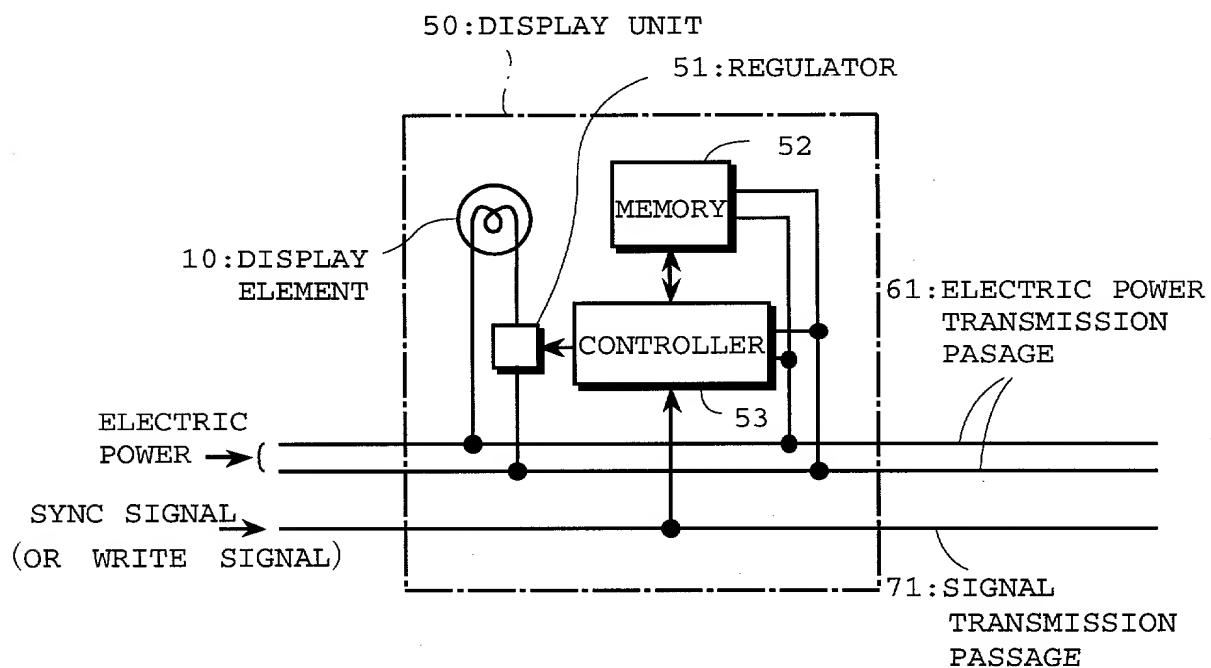
Fig.5**Fig.6**

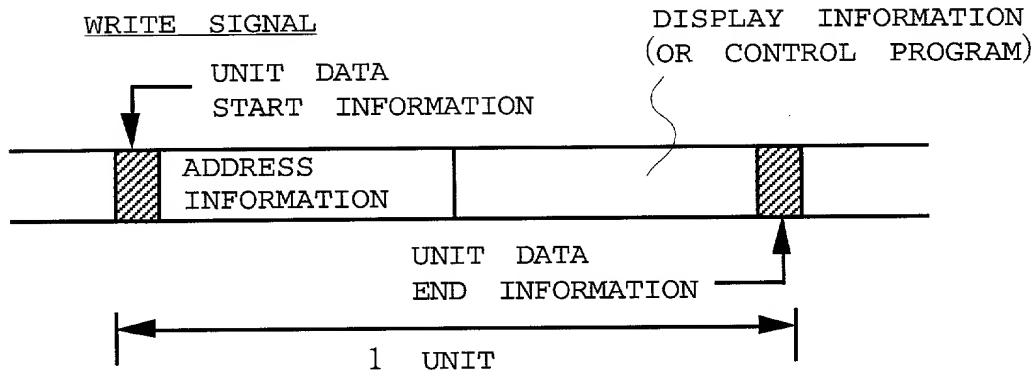
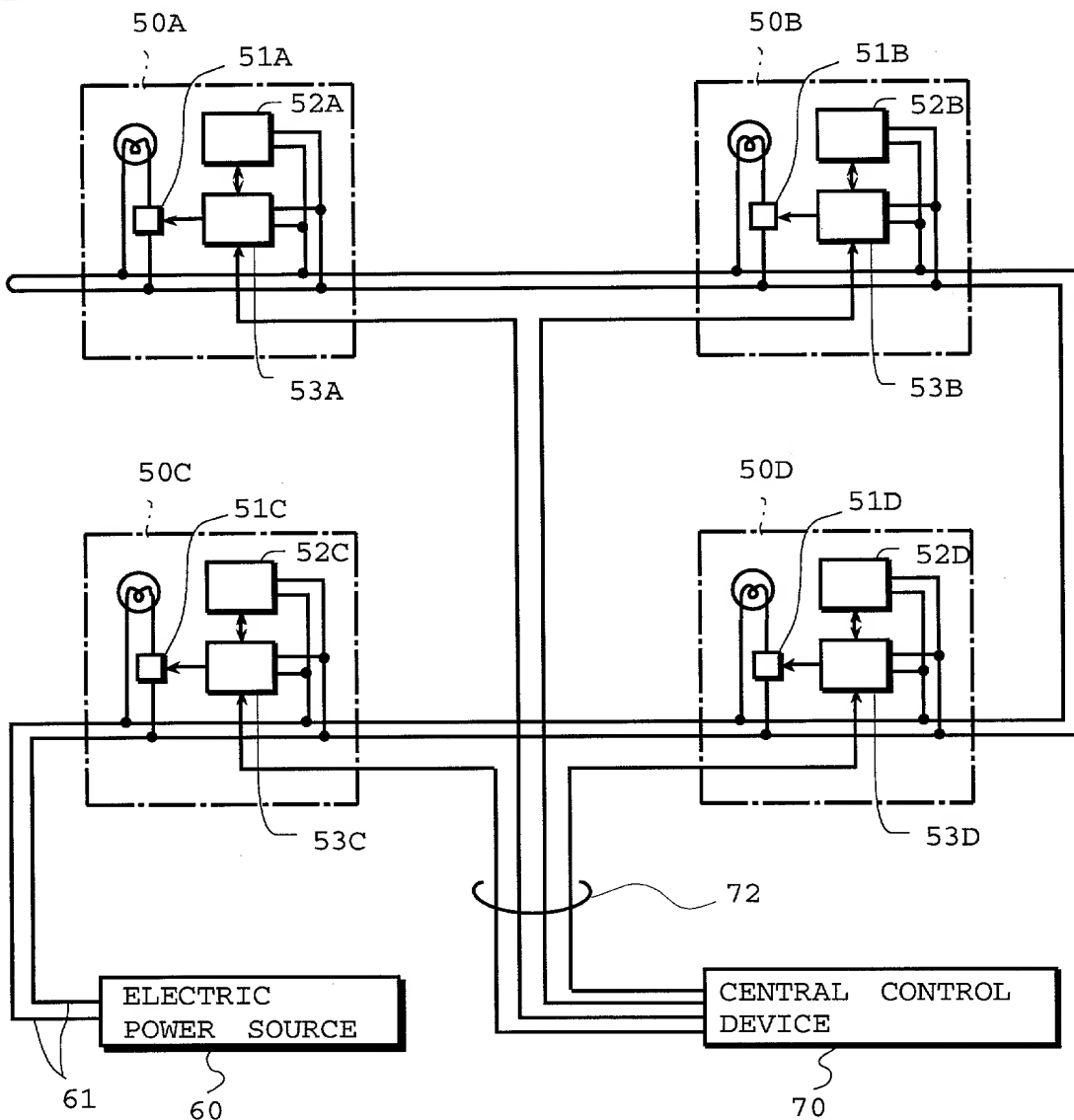
Fig.7**Fig.8**

Fig.9

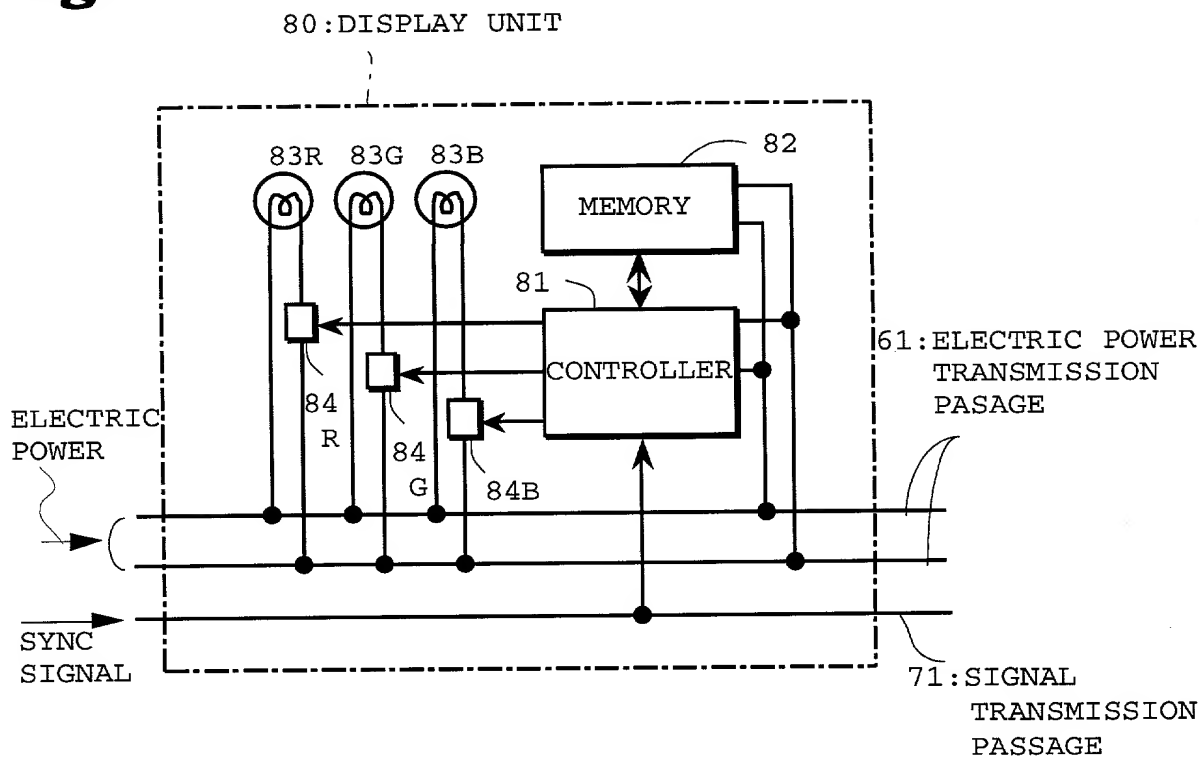


Fig.10

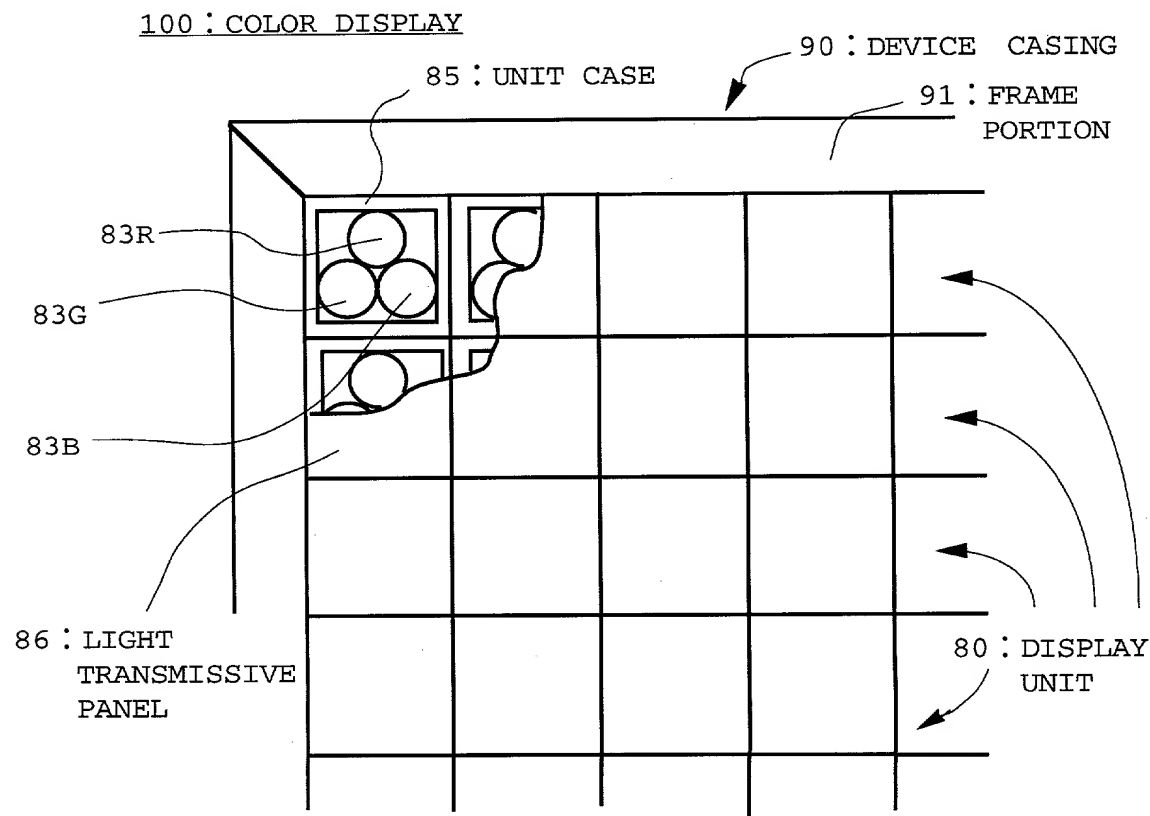
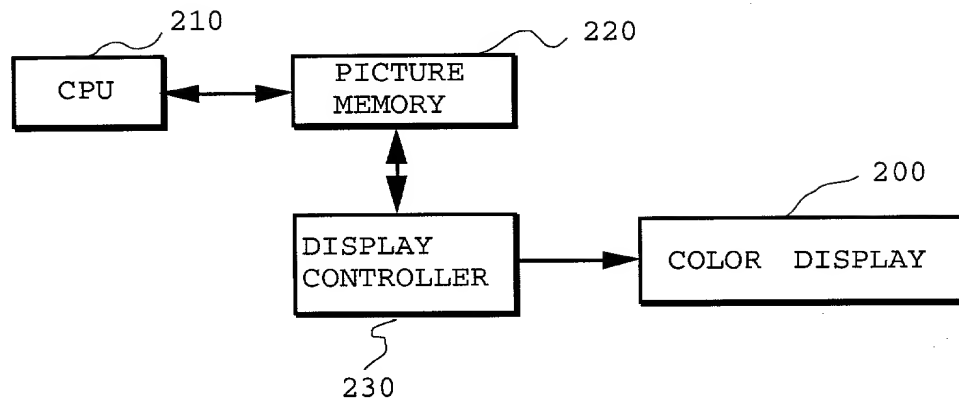


Fig.11PRIOR ART**Fig.12**300 : COLOR DISPLAY